DoD's Energy Security Strategy

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Strategic Drivers

"This is our chance to step up and serve. The war against international terrorism has pitted us against a new kind of enemy that wages terror in new and unconventional ways. At home, fighting that enemy won't require us to build the massive war machine that Franklin Roosevelt called for so many years ago, but **it will require us to harness our own renewable forms of energy so that oil can never be used as a weapon against America**.

Speech - Energy Security is National Security, February 2006

"…The **well-being of the global economy is contingent on ready access to energy resources**. Notwithstanding national efforts to reduce dependence on oil, **current trends indicate an increasing reliance on petroleum products from areas of instability** in the coming years, not reduced reliance. The [US] will continue to foster access to and flow of energy resources vital to the world economy. Further, the Department is examining its own energy demands and is taking action to reduce fuel demand where it will not negatively affect operational capability. **Such efforts will reduce DoD fuel costs and assist wider U.S. Government energy security and environmental objectives**."

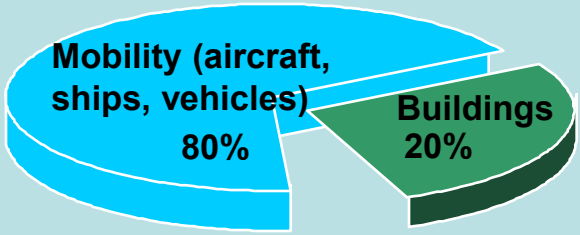
National Defense Strategy June 2008

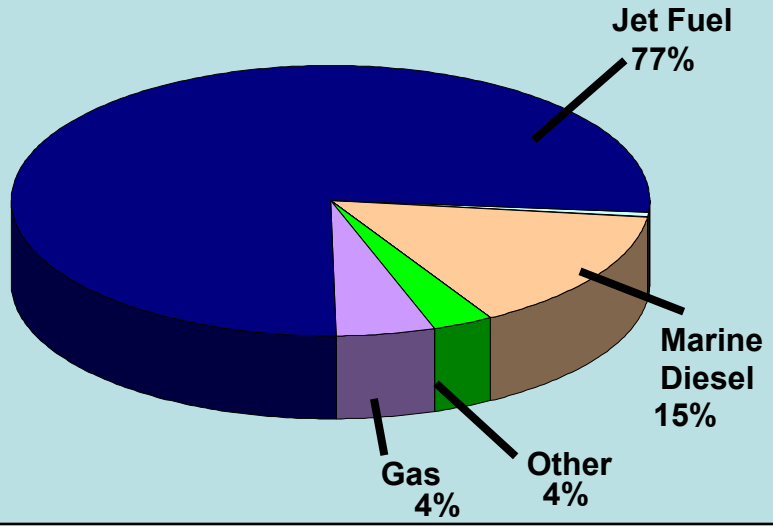
U.S. Marine Corps Maj. Gen. Richard Zilmer, Al-Anbar Commander, submitted an **urgent request for renewable energy systems**, due to the vulnerability of American supply lines to insurgent attack by ambush or roadside bombs. The request said "**reducing the military's dependence on fuel for power generation could reduce the number of road-bound convoys**." …'Without this solution [renewable energy systems], personnel loss rates are likely to continue at their current rate. Continued casualty accumulation exhibits potential to jeopardize mission success…'"

Defense News, August 2006

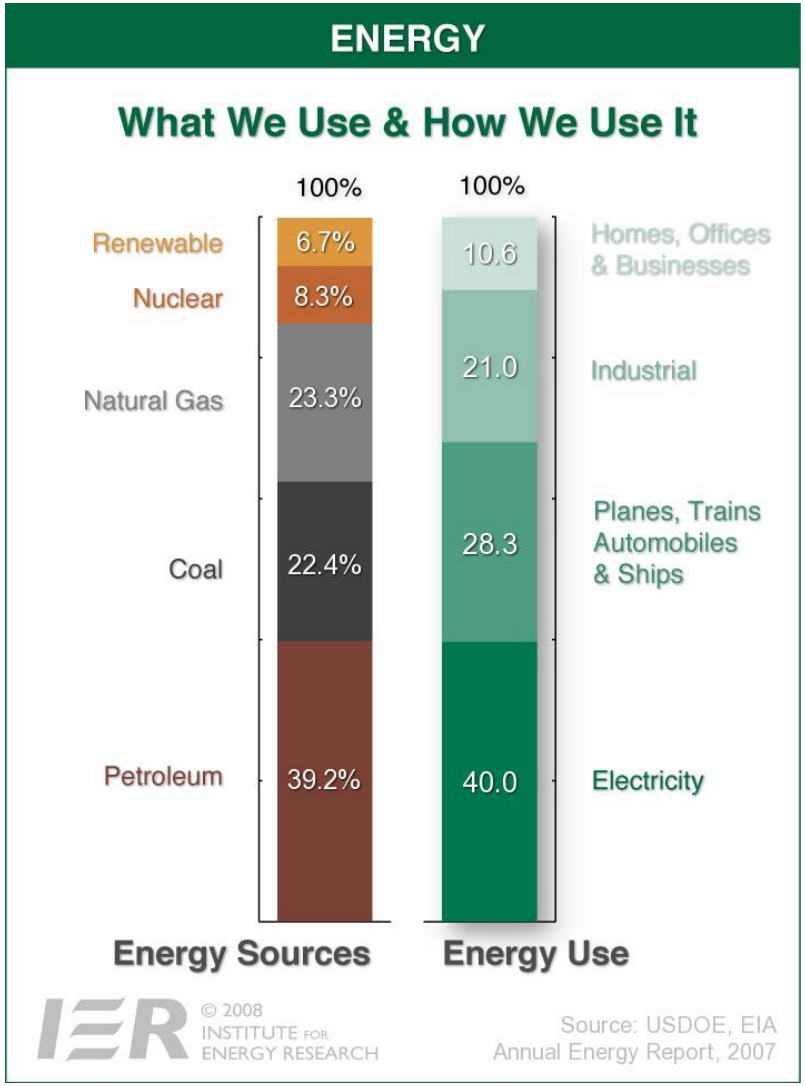
DoD Energy Use

DoD FY08 Consumption (by BTUs)





DoD Energy Use Statistics



US Energy Use Statistics

DoD Energy Cost Drivers

- DoD spent over $20B on energy in FY08
- $1.23T spent on energy nationwide in FY08
- Army Wartime OPTEMPO impacts:
  - Generator fuel usage increase x14
  - 26MGal in peacetime to 357MGal
  - Generators - largest Army user of fuel
    - > Combat vehicles
    - > Combat aircraft
    - > Tactical vehicles

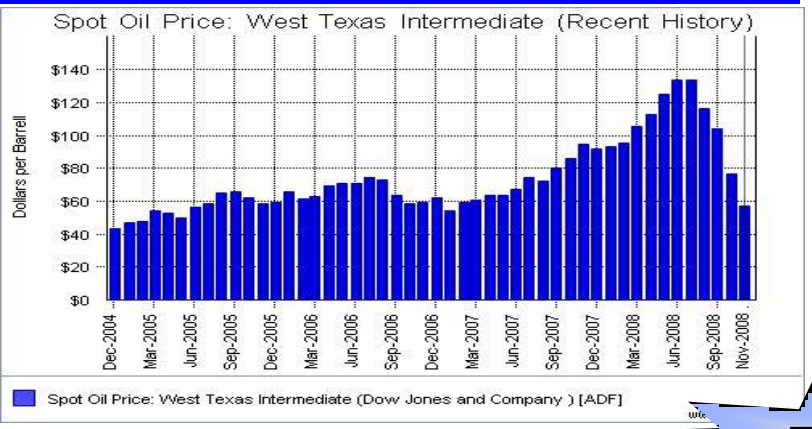
COST PAYOFF: Reduced energy use for mobility, fixed and tactical installations

OPERATIONAL PAYOFF: Fewer refuelings; increased platform availability

Both support enhanced energy focus and free up resources to apply elsewhere

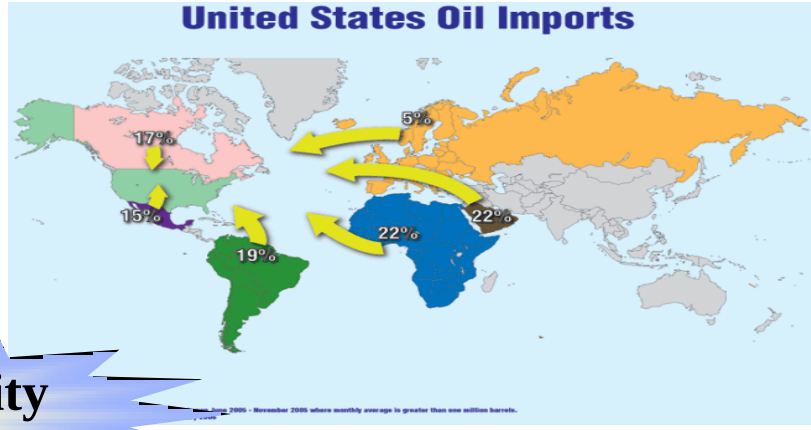
DoD Energy Security Drivers

Price Volatility Impacts Other Programs



US Oil Sources May Not Be Stable

Source: EIA, Period Aug 07- JaN 08



Energy Security Drivers

Logistics of Moving Fuel Can Limit Combat OPS

Modern Military Systems Use of Energy Increasing

DoD Energy Security Drivers
--Wild Cards--

Influence from Global Suppliers

Price of oil bounces off four-year lows

OPEC president suggests large production cut on the way

Associated Press December 8, 2008 @ 1700

Oil prices rebounded from four-year lows and shot above $43 a barrel Monday as OPEC floated the possibility of a "severe" production cut and several countries announced new measures to boost their economies...

Humanitarian Relief

Future Systems

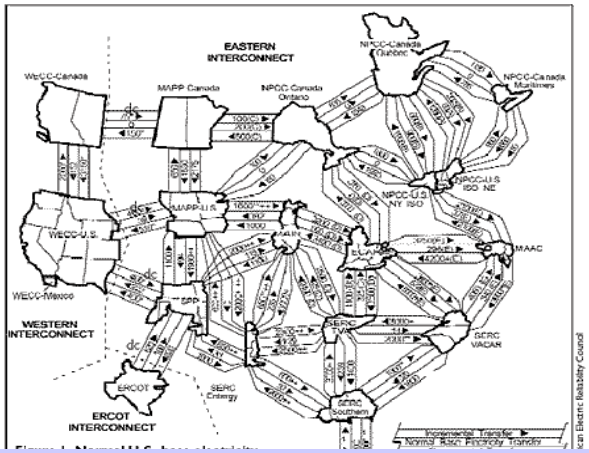
Russia wields the energy weapon

BBC News, Moscow, February 14, 2006

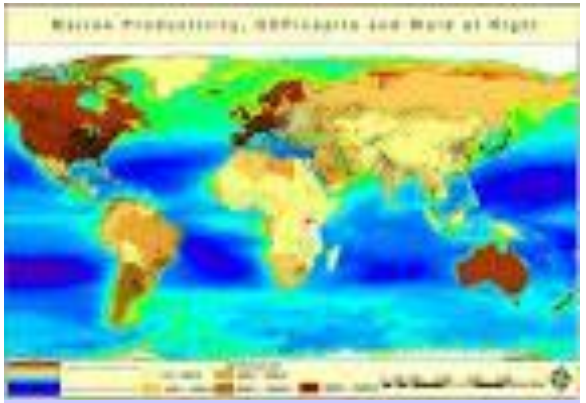
When Russia turned off the gas to Ukraine, it sent shivers across Europe where customers are increasingly dependent on Russia to keep warm.

Energy Security Drivers

Energy as a Strategic "Weapon"



Grid Vulnerability



Climate Change????

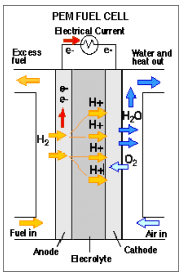
Energy Security Challenge

Supply Security

Demand Reduction

Supply

- **Conventional fossil fuels**
- **Synthetic fuels** (e.g. coal, natural gas derived fuels)
- **Other alternative fuels** (e.g. renewable jet and diesel, biomass, alcohols, hydrogen, etc.)
- **Renewables** (e.g. solar, geothermal, wind, wave/ocean)
- **Novel supply** (e.g. fuel cells)
- **Nuclear**
- **Exotics** (e.g. isomers)
- **Local electrical grid**



Demand

- **Conservation Initiatives**
- **Fixed base**
- **Tactical base**
- **Platforms**
- **Efficiency**
- **Life-Cycle Cost**

Assured Distribution

- **Direct oil / fossil fuel costs**
- **Policy, processes and risk assessment**
- **Refining capacity**
- **Energy availability**
- **Doctrine**

Convergence for Energy Security

DoD Focuses on Energy

- DoD is proactively responding to the energy challenge
  - Established DoD and Service Task Forces
    - Services designated energy leads
    - DoD and each Service developed strategic plans
  - Increased investment in energy initiatives
    - From $440M in FY06 to ~$1.2B in FY09
  - DoD has directed us of fuel efficiency in acquisition decisions
  - DoD has maintained Energy Security Task Force

DoD Progress to Date

- Finalized strategic plan, providing a framework for considering and valuing energy across DoD
- Consistent with the strategy, DoD has a number of ongoing initiatives
  - Since 2005, DoD total energy demands down 6%
  - Since 2003, DoD installation energy demand down 10%
  - DoD gets almost 12% of its electricity from renewables
  - Revising requirements and acquisition processes
    - Energy as a selective key performance parameter
    - Inclusion of fully burdened cost of fuel in acquisition programs

DoD is making progress in energy security

DoD Energy Security Strategic Plan

- Four overarching goals:
  - Maintain or enhance operational effectiveness by reducing total force energy demands
  - Increase energy strategic resilience by developing alternative/assured fuels and energy
  - Enhance operational and business effectiveness by institutionalizing energy considerations and solutions in DoD planning & business processes
  - Establish and monitor Department-wide energy metrics

Ongoing Activity, Goals 1 and 2

- Installations -

- Each Service has active programs or pilots to reduce installation energy and increase resilience
- Example programs

Army

- **Net zero pilot, Ft. Irwin**
  - **–$25M upfront cost**
  - **–$105M savings in 5 years**
- **Tent foam, Iraq**
  - **–$95M upfront cost**
  - **–Estimated reduction $300K+/day**
- **Energy efficient housing demo, Ft. Belvoir**

Navy

- **Existing geothermal plant, China Lake, CA**
  - **–270 MW (supports ~180,000 households)**
- **Building geothermal plant at NAS Fallon**
  - **–Working with Hawthorne Army Depot**

Air Force

- **Infrastructure Energy Plan**
  - **–Facility energy intensity -13% since FY03**
- **New solar farm, Nellis AFB, NV**
  - **–Powers 25% of base**
- **Testing waste-to-energy systems**

Eskimo Spray Foam Insulation

- Already Accomplished in Theater -

DESCRIPTION

- US Army Rapid Equipping Force funded approx $10M to spray foam over half million sqft
- MNF-I awarded $95M contract to foam additional 9 million sqft; similar contract being awarded in Afghanistan
- Spray Foam insulation addresses the demand side – 75% reduction is typical
- Unless connected to a commercial utility or large Prime Power Grid, action must be taken to address the supply side to realize savings (turn off spot generators, install FOB Prime Power Grid, etc).

BENEFITS/METRICS

- Reduces Coalition risk on lines of communication by reducing external fuel requirements
- Metric 1: Gallons of Conventional Fuel required to power an Enduring Forward Operating Base/Facility
- Metric 2: $/kWh of electricity at Enduring Forward Operating Base/Facility

Gym, Iraq

Gym, Djibouti

FOB, Afghanistan

Tent, Kuwait

FUNDING REQUIREMENTS

n/a -- Demo Projects Completed
MNF-I has "Ownership" of Way Ahead

Ongoing Activity, Goals 1 and 2

- Platforms -

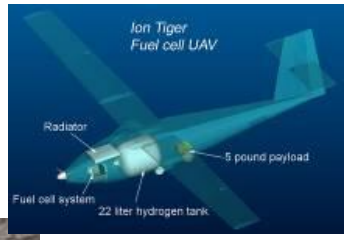
- Each Service has active programs or pilots to reduce platform energy and increase resilience
- Example programs

Army

- **Fuel Efficient Ground Vehicle Demonstrator**
  - –30-40% increased efficiency
- **Thermal Management**
- **Rotorcraft Advanced Turbine Engine**
  - –25% decrease in fuel consumption with increased horsepower

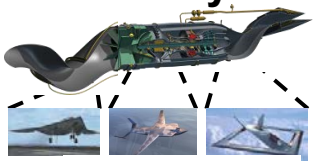
Navy

- **Solid oxide fuel cells**
- **Reduced friction coatings for propellers**
  - –5+% increased efficiency
- **UAVs/UUVs**



Air Force

- **Advanced Turbine Research**
  - –25% increased efficiency
- **Efficient engines for UAVs and generators**
  - –20% increased efficiency
- **Synfuel certification ongoing**
  - –Goal: Fleet certification by 2011



UAV Transports ISR

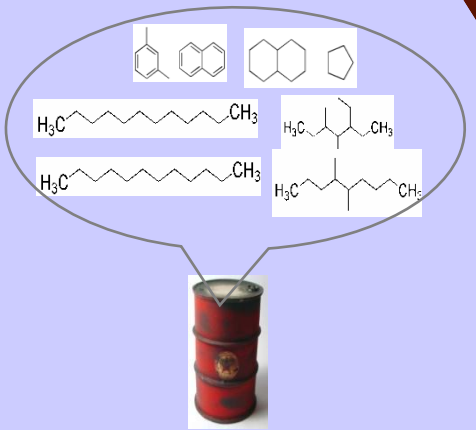
Increase Alternatives – Jet Fuel

- *Biofuels* -

- BioFuels: Alternate Feedstocks
  - **Objective: An alternative and affordable feedstock**
  - **Currently, large scale production provides algal oil for > $20/gal**
  - **Key technical challenges:**
    - **Integrating advances in growth systems**
    - **Nutrition management**
    - **Cropstock selection**
    - **Waste stream management**
    - **Intermediate product extraction**

- Program Metrics
  - **Phase I**
    - **< $2/gal triglyceride oil from algae**
    - **Projected cost of production of JP-8 < $3/gal at 50 Mgal/yr**
  - **Phase II**
    - **< $1/gal triglyceride oil from algae**
    - **Projected cost of production of JP-8 < $3/gal at 50 Mgal/yr**

"Build-down" process:
Crack/re-arrange C12-C16



Goal 3: Include Energy in Planning and Business Processes

EXAMPLES

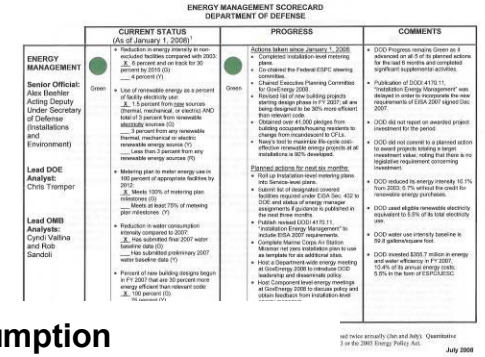
Planning and Analysis

- DoD strategic plan in work
- Component-designated energy leads/organizational structures
- Component-developed strategic plans
- Revising Analytic Agenda products (Defense Planning Scenarios, Multi-Service Force Deployments, and Analytic Baselines) to include fuel considerations
- JS simulator study – initial results show potential for large savings

Acquisition

- Energy as KPP
- Fully Burdened Cost of Fuel pilot for life cycle energy costing
- Decisions based on return on investment (monetary and capability)
- Lifecycle/Total ownership costs
- Long-term contracts for alternative fuels

Goal 4: Establish and Monitor Department-wide Energy Metrics

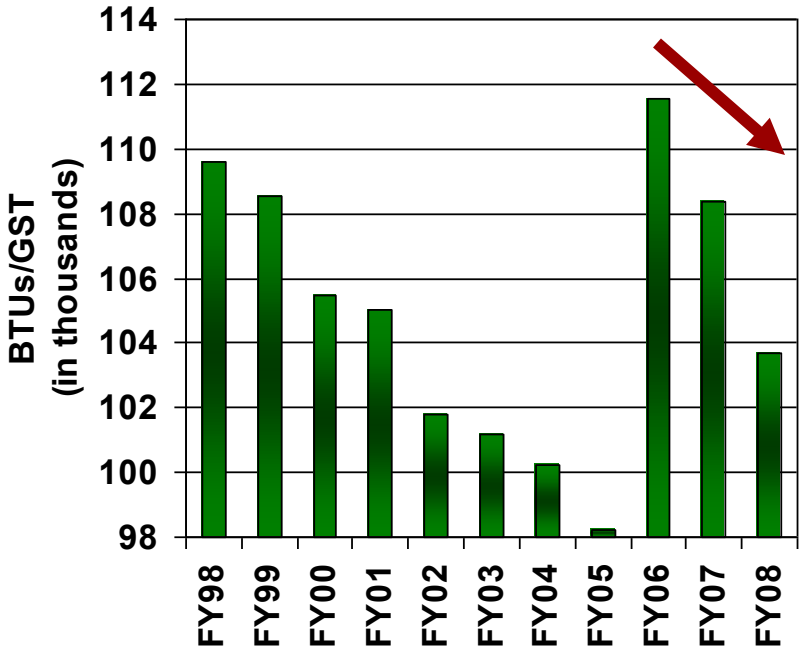

ENERGY MANAGEMENT SCORECARD
DEPARTMENT OF DEFENSE

ENERGY MANAGEMENT	CURRENT STATUS (As of January 1, 2008)[1]	PROGRESS	COMMENTS
Senior Official: Alex Beehler Acting Deputy Under Secretary of Defense (Installations and Environment) **Lead DOE Analyst:** Chris Tremper **Lead OMB Analysts:** Cyndi Vallina and Rob Sandoli	Green • Reduction in energy intensity in non-excluded facilities compared with 2003: X (reduction in energy intensity in non-excluded facilities compared with 2003); 6 percent and on track for 30 percent by 2015 (G); 4 percent (Y) • Use of renewable energy as a percent of facility electricity use: X (1.5 percent from new sources (thermal, mechanical, or electric) AND total of 3 percent from renewable electricity sources (G); 3 percent from any renewable thermal, mechanical or electric renewable energy source (Y) • Metering plan to meter energy use in 100 percent of appropriate facilities by 2012: X (Meets 100% of metering plan milestones (G); Meets at least 75% of metering plan milestones (Y) • Reduction in water consumption intensity compared to 2007: X (Has submitted final 2007 water baseline data (G); Has submitted preliminary 2007 water baseline data (Y) • Percent of new building designs begun in FY 2007 that are 30 percent more energy efficient than relevant code: X (30 percent (G)	Green Actions taken since January 1, 2008: • Completed installation-level metering plans. • Co-chaired the Federal ESPC steering committee. • Chaired Executive Planning Committee for GovEnergy 2008. • Revised list of nine building projects starting design phase in FY 2007; all are being designed to be 30% more efficient than relevant code. • Obtained over 41,000 pledges from building occupants/housing residents to change from incandescent to CFLs. • Navy's tool to maximize life-cycle cost-effective renewable energy projects at all installations is 90% developed. Planned actions for next six months: • Roll up installation-level metering plans into Service-level plans. • Submit list of designated covered facilities required under EISA Sec. 432 to DOE and status of energy manager assignments if guidance is published in the next three months. • Publish revised DOD 4170.11, "Installation Energy Management" to include EISA 2007 requirements. • Complete Marine Corps Air Station Miramar net zero installation plan to use as template for six additional sites. • Host a Department-wide energy meeting at GovEnergy 2008 to introduce DOD leadership and disseminate policy. • Host Component level energy meetings at GovEnergy 2008 to discuss policy and obtain feedback from installation-level	• DOD Progress remains Green as it advanced on all 5 of its planned actions for the last 6 months and completed significant supplemental activities. • Publication of DODI 4170.11, "Installation Energy Management" was delayed in order to incorporate the new requirements of EISA 2007 signed Dec 2007. • DOD did not report on awarded project investment for the period. • DOD did not commit to a planned action to award projects totaling a target investment value; noting that there is no statutory requirement concerning investment. • DOD reduced its energy intensity 10.1% from 2003; 6.7% without the credit for renewable energy purchases. • DOD used eligible renewable electricity equivalent to 5.6% of its total electricity use. • DOD water use intensity baseline is: 89.8 gallons/square foot. • DOD invested $265.7 million in energy and water efficiency in FY 2007; 10.4% of its annual energy costs; 5.6% in the form of ESPC/UESC.

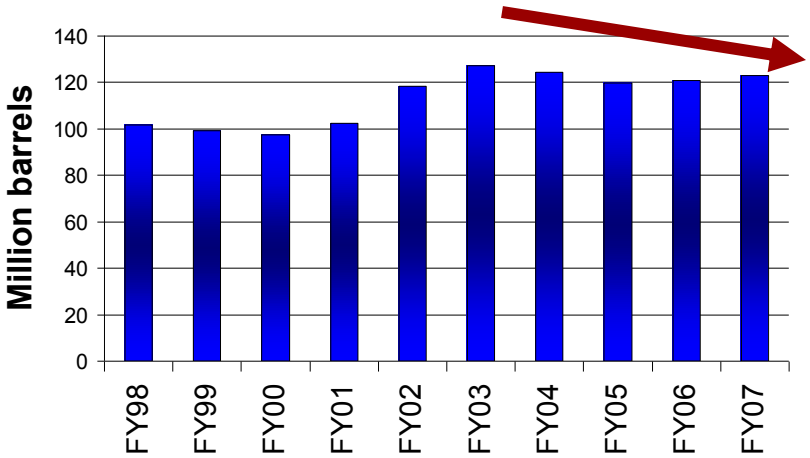
[1] ad hoc or annually (Jan and July); Quantitative
3 of the 2005 Energy Policy Act.

July 2008

Facilities Energy Consumption (BTUs/GSF)



DoD Fuel Consumption

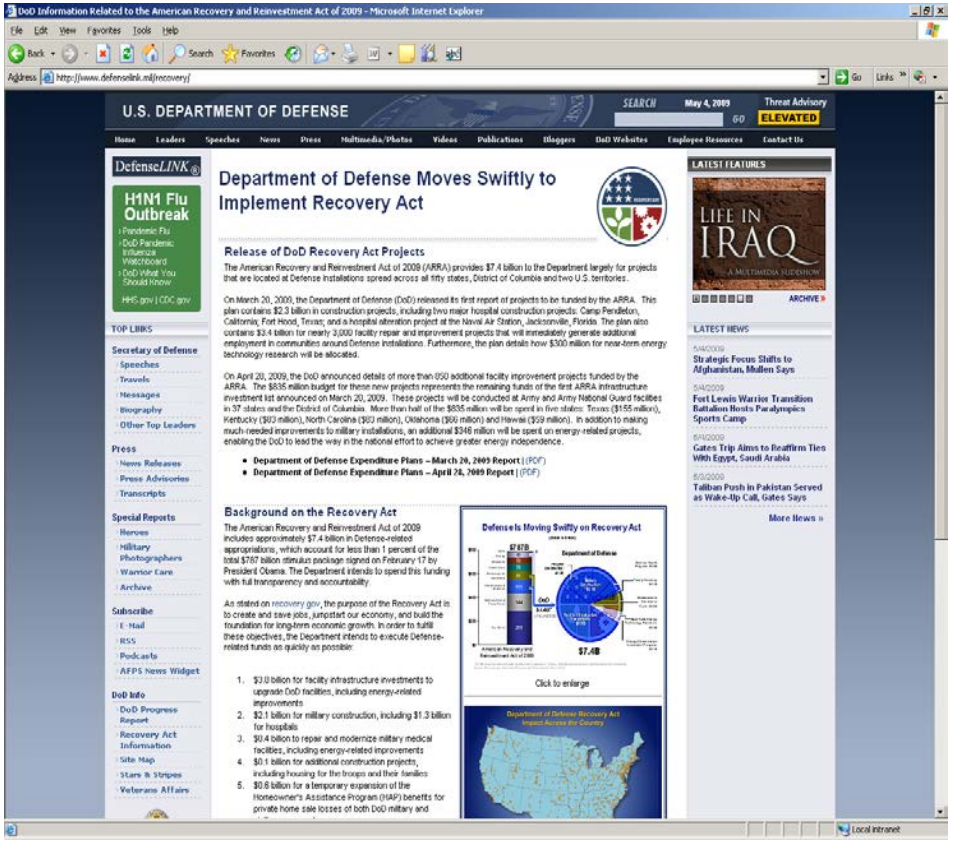


The Installations Community has targets for energy reduction, and consumption has generally gone down. How can we adapt this concept for platforms?

** *Note*: EPAct 2005 reset the FY03 baseline and incorporated industrial facilities into the baseline, beginning with the FY06 data submission.

DoD Energy and the American Reinvestment and Recovery Act

- DoD received $300M in Stimulus Bill for energy research
- Multiple projects – fuel cells, ground vehicles, hybrid motors, etc.
- List and competition rules may be found at http://www.defenselink.mil/recovery/



Next Steps

- Determine how new Director of Operational Energy Plans and Programs will interact with ongoing groups
  - Per Section 902 of the FY09 National Defense Authorization Act
- Establish platform goals
- Develop cost estimates to achieve specific levels of energy security/assured fuels
- Investigate/develop self-sustaining energy conservation fund
  - Pilot to develop methodologies and processes in work
  - Using 6 ongoing projects as test cases
- Implement fully burdened cost of fuel in acquisition processes and associated directives and decisions
- Develop business case for alternative fuels, including environmental impacts

Summary

- There is more work to be done, but DoD is making progress in energy security
- DoD's energy strategy balances demand reduction and assured alternative sources
- Our energy efforts will
  - Increase operational capability for the warfighters
  - Reduce costs
  - Help the nation reduce its dependence on oil

BACKUP

Ground Combat Vehicle Evolution

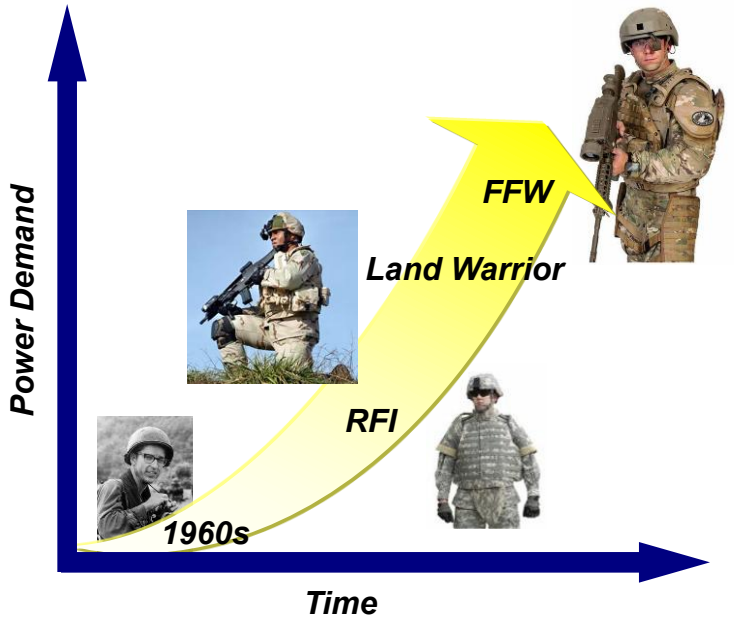
M47 Patton

- FM Radio
- Direct View Optics
- Engine Gauges
- Ballistic Periscopes

M1A2 Abrams

- Secure data/voice radio
- Thermal Viewer
- FBCB2 Digital Battle Command
- Digital Fire Control
- 1 Color/3 Monochromatic Displays

Soldier as System Evolution



Late 1960s Soldier

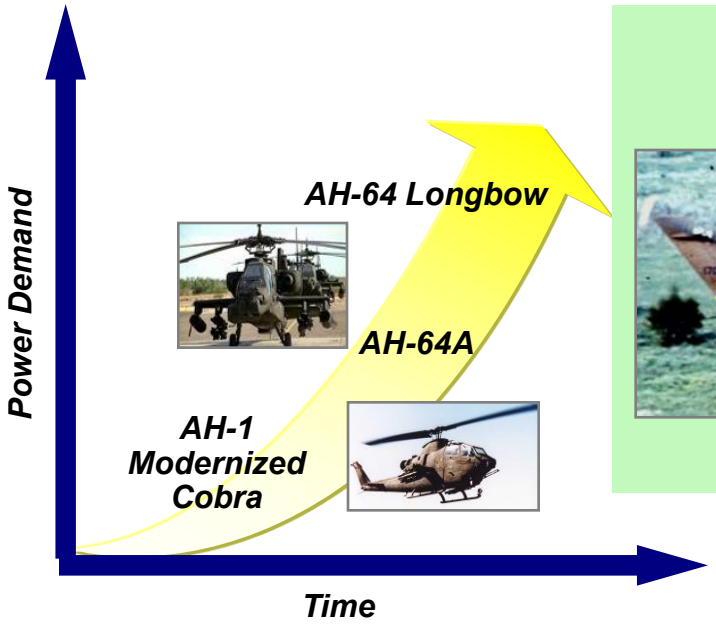
- FM radio
- Early I^2 devices
- Binoculars
- M-16 with daylight scope

Handheld Soldier Display

Future Force Warrior (FFW)

- Integrated body armor & equipment carriage suite
- Helmet mounted thermal imaging
- Radio digitally linked to unit communications network displaying individual locations
- Laser aided weapon precision fire control
- Embedded training

Helicopter Evolution



AH-1 G Cobra

- FM Radio
- Direct View Optics
- 2.75 inch rockets and 7.62mm machine gun

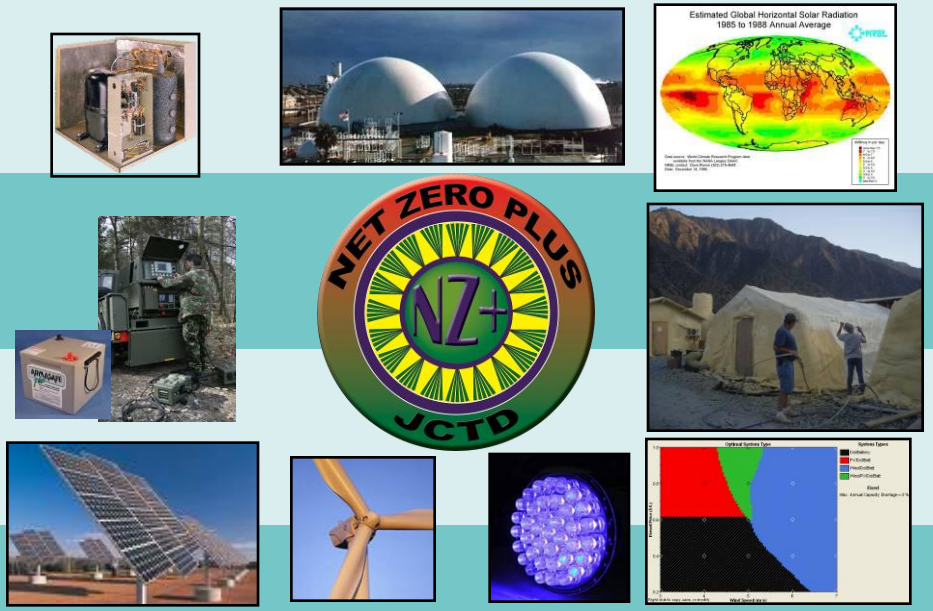
AH-64 Apache Longbow

- Secure data/voice radio
- Integrated pilot night vision system
- Digital fire control linking gunners view & weapons systems
- Longbow MMW radar
- Hellfire missiles and 30mm cannon
- Survivable rotors—up to 23mm AA

Reduce Consumption/Increase Alternatives
- Net Zero Plus JCTD -

DESCRIPTION

- Reduce fuel requirements of Forward Operating Bases (FOB) through reduced energy demand, efficient power distribution & increased alternative supply
- Emphasis on energy efficient structures & technology; Smart power generation that measures, analyzes, and connects power flow; Integration of renewable and conventional energy generation to provide assured power using less fuel



BENEFITS/METRICS

- Already Completed: $1.5M Power Surety Task Force/Army REF Net Zero Structure (NZS) at National Training Center (NTC); initial data analysis on Dome power.
- In-Progress: Data recording; Spray foam of tents.
- Future Efforts: Alternative energy efficient structures; Smart power generation; Prime Hybrid Power; Waste to Energy; Efficient Lighting; Transition to Theater & PMs

Timeline

Annual Spinout through FY11

Reduce Consumption - Ground Vehicles
- Fuel Efficient Ground Vehicle Demonstrator -

DESCRIPTION

- Identify opportunities in fuel efficient technologies, lightweight components and armor, reduced weight structure/ frame, efficient propulsion/driveline and others
- Build a virtual vehicle to predict performance, set objectives and establish test criteria
- Demonstrate decreased fuel consumption, without decreasing performance or capability, in a tactical vehicle using innovative design, advanced lightweight materials and fuel efficient components

BENEFITS

- Leverages on-going S&T investments and efforts supporting HMMWV replacement
- Baseline is Heavy HMMWV Capabilities - Fuel savings estimated 30-40%

Reduce Consumption
- Fuel Efficient Propeller Coatings -

DESCRIPTION

- Evaluate propeller coatings for cavitation erosion resistance and antifouling properties. Candidate materials could include metal borides and nanomaterials-based metal oxide.
- Test fuel savings in lab for candidates and evaluate performance of optimum coating in at-sea tests.
- Production cost: ~$200K/ship

BENEFITS/METRICS

- Anticipate 4-5% fuel efficiency
- Additional benefits: reduced cavitation erosion and antifouling benefits, resulting in reduced maintenance costs

---

- ROI: 5% savings on $2.8B annual fuel bill ($14.17M for 200 ships) ≈ $142M/yr

Payback

Applying this technology to 200 ships @ $200K/ship:
Payback ~ < 1yr

Air Force
Alternative Aviation Fuels Certification

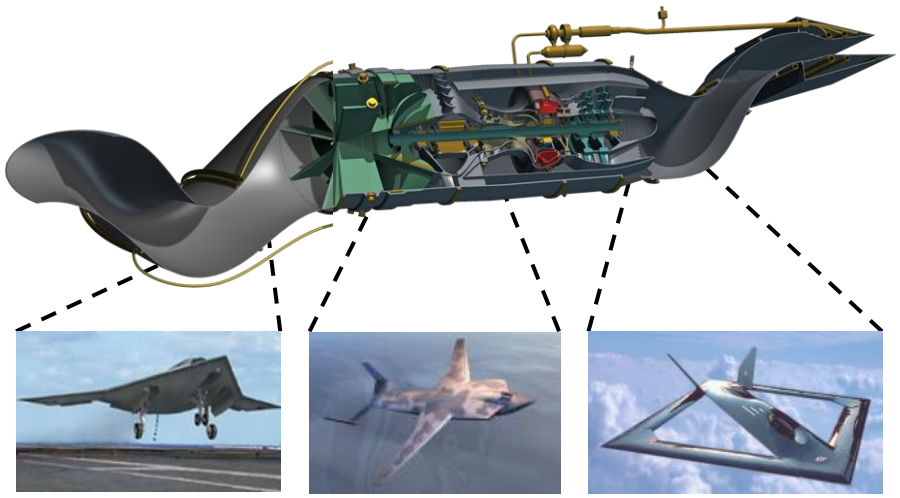
- **Synthetic alternative aviation fuel blend certification**
  - **On track to meet 2011 goal: on schedule and under budget**
- **Biomass-derived alternative aviation fuel blend certification**
  - **Supports 2016 goal: new effort recently approved**

Alternative Fuels Enhance Long-term National Security

Reduce Consumption - Air Platforms
- Highly Efficient Embedded Turbine Engine -

DESCRIPTION

- Accelerate development of fuel efficient, high-bypass subsonic propulsion in an embedded configuration
- Supports future ISR, mobility, and UCAV extreme endurance and range requirements
- High power extraction for multi-sensor suites is an integral part of program
- Addresses more than 80% of the aircraft fleet (mobility, fighters, etc.)



UAV's | Transports | ISR

BENEFITS

- Theoretical performance enhancements of the concepts are:
  - 25% reduction in fuel consumption
  - 100-400 kW power extraction capability

Goal 3: Include Energy in Planning and Business Processes

EXAMPLES

Planning and Analysis

- DoD strategic plan in work
- Component-designated energy leads/organizational structures
- Component-developed strategic plans
- Revising Analytic Agenda products (Defense Planning Scenarios, Multi-Service Force Deployments, and Analytic Baselines) to include fuel considerations
- JS simulator study – initial results show potential for large savings

Acquisition

- Energy as KPP
- Fully Burdened Cost of Fuel pilot for life cycle energy costing
- Decisions based on return on investment (monetary and capability)
- Lifecycle/Total ownership costs
- Long-term contracts for alternative fuels

Air Force Energy Strategy

Army Energy Strategy

RDT&E Recovery Act Projects
- Selection Process -

- ~$550+M initial inputs based on
  - $87.5M per Service + additional $200M DW
  - 138 proposals submitted
- Binned projects into broad categories used by the Energy Security Task Force
- Convened Senior and Action Officer level working groups with Service energy leads to de-conflict / leverage projects
- Final list: $75M per Component for RDT&E energy projects - $300M total
- Project prioritization
  - Projects must be able to be executed quickly
  - Projects must be consistent with Energy Security Strategic Plan
  - Projects were not allowed to “fix” existing acquisition programs
  - Projects could not create outyear tails
- Final submittal / approval from Service Principals
  - 51 Total: (8 Army; 11 Navy; 17 AF; 15 DW)

Energy Categories

- Fuel Optimization for Mobility Platforms
  - Propulsion/Electric Drive/Engine Efficiency
  - Aircraft Fuel Efficiency
  - Ship Fuel Efficiency
  - Logistics
- Operational Efficiencies/ Commercial Practices
  - Operational Changes (e.g. mission routing/planning, distributed operations training)
- Facility Energy Initiatives
  - Facility Energy Initiatives
- Domestic Energy Supply/ Distribution
  - Alternative Fuels
  - Renewable Power Systems R&D
  - Nuclear Power
- Tactical Power Systems/ Generators
  - Fuel Cells
  - Generators
  - Tactical Micro-grids

DoD Energy Program

- RDT&E Recovery Act Projects Summary -

($ M)

Fuel Optimization for Mobility Platforms	$ 134.9	Propulsion / Energy Efficiency; Aircraft Fuel Efficiency; Ship Fuel Efficiency; Logistics
Operational Efficiencies / Commercial Practices	$ 3.0	Operational Changes (e.g. mission routing/planning, distributed operations training)
Facility Energy Initiatives	$ 22.5	Facility Energy Initiatives
Domestic Energy Supply / Distribution	$ 105.1	Alternative Fuels; Renewable Power Systems R & D; Nuclear Power
Tactical Power Systems / Generators	$ 34.5	Fuel Cells; Generators; Tactical Micro-Grids
TOTAL FUNDING	**$ 300.0**	